HATAKOSHI Repair of Inguinal Hernia and Our Application of his Method

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HATAKOSHI Repair of Inguinal Hernia and Our Application of his Method

by

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I. HATAKOSHI METHOD

In 1912, HATAKOSHI introduced a new method for the repair of inguinal hernia, which has now proved to be of value for over 50 years. Primarily, it consisted of leaving the divided sac in situ, rather than extirpating it. The essential features of his method, one of the best in the history of hernia repair, are as follows: 1) The hernia sac is ligated and divided high at its neck in the area of the internal inguinal ring (Figs. 1, 2). The divided hernia sac is left in situ. 3) The Linea semilunaris SPIEGELI (the borderline between the fibers of the transversus abdominis muscle and its aponeurosis) is joined by several sutures to the inguinal ligament just above the internal inguinal ring (Figs. 2, 3). He referred to this as "Pfortnaht". 4) Sutures are placed in the external oblique

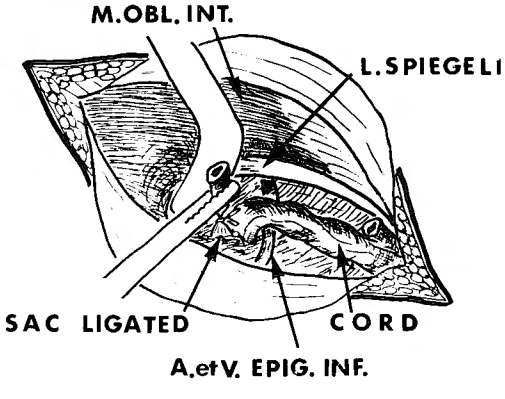

Fig. 1 The hernial sac is ligated and divided high at its neck.

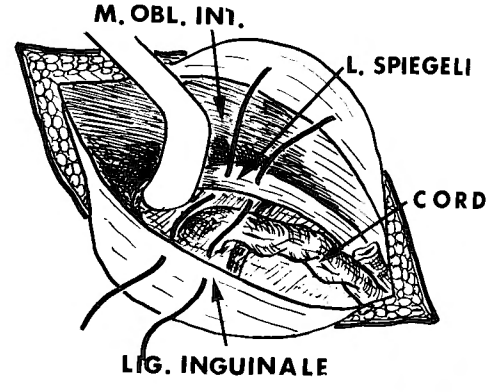

Fig. 2 Approximation of the Linea SPIEGELI to the inguinal ligament, just above the internal ring.

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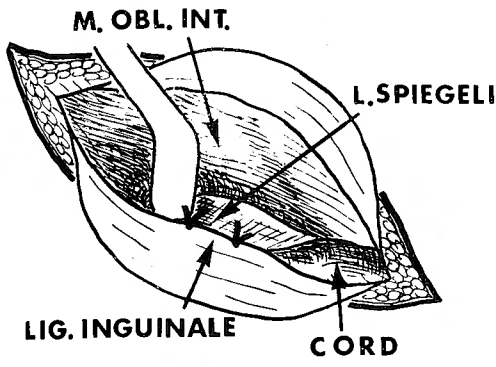


Fig. 3 Suture just above the internal ring, (Pfortnaht).

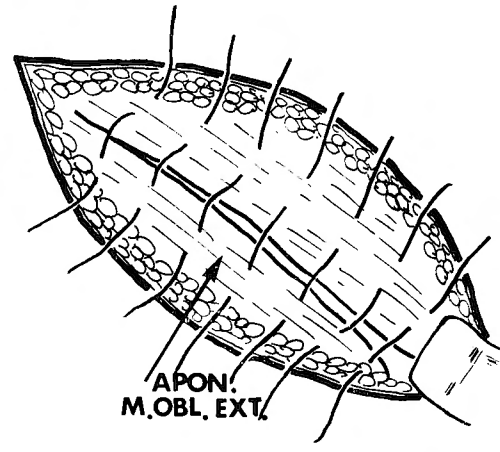


Fig. 4 Closure of the external oblique aponeurosis, (Kanalnaht).

aponeurosis along the anterior wall of the inguinal canal (Fig. 4). He referred to this as "Kanalnaht" (canal suture). It is a critical feature of his method for it plays a major role in preventing post-operative recurrence of the hernia. HATAKOSHI states that the further down in the canal the suture is extended, the better the reinforcement of the inguinal canal. The lowermost end of the suture line should narrow the slit of cruses (crus mediale et laterale) which form the external inguinal ring. The latter is secured by approximating the portion of the inguinal ligament, 1-2 cm lateral to the pubic tubercle, to the outer edge of the rectus sheath near the pubic bone. He also recommended that the reconstructed inguinal canal should be narrowed anteriorly to the spermatic cord so that there is only room for the tip of the little finger alongside the spermatic cord structures. He firmly stated that narrowing of the internal inguinal ring alone would not serve to completely cure inguinal hernias.

We also have made efforts to improve the technique for hernia repair. MURAKAMI began developing his method during residency training at Kyoto University Hospital, 35 years ago. Starting with the original HATAKOSHI method, he has combined it with features from several methods including those POTTS, CHAMPIONIÈRE, BASSINI and others.

II. PROCEDURES AND OPERATIVE TECHNIQUES THAT WE ARE CURRENTLY USING ARE AS FOLLOWS

1) *Indication for surgery*

For new born infants, the hernia repair is usually performed after the age of three months unless an emergency exists in the form of an incarceration. Fortunately, incarceration is rare during the newborn period. At all ages, non-emergency operations are performed when the patient is completely well because even coughing from a minor cold may mar otherwise successful surgery.

2) *Anesthesia*

Patients are routinely fasted for three hours before surgery, and atropine is administered subcutaneously 30 minutes preoperatively. For infants under the age of one year, closed or semiclosed general anesthesia with N_2O and Fluothane is the procedure of choice unless there is a specific contraindication. For infants above the age of one year, spinal

anesthesia is usually the method of choice preceded by the intramuscular administration of a hibernetic cocktail consisting of chlorpromazine, pethidine hydrochloride, and promethadine hydrochloride. For children above 5-6 years of age and adults the prespinal medication consists of just pethidine hydrochloride. General anesthesia is used for emergency cases and for the over 60 age group.

3) *Operative techniques*

I) The skin and superficialis fascia are incised transversally along Langer's skin crease, centered at the point above the internal inguinal ring for infants but diagonally in accord with the slant course of the inguinal canal for older patients. The skin incision is 3-12 cm long, depending upon the age and height of the patient or the operative method chosen.

II) In adults, the external oblique aponeurosis is incised in the direction of its fibers over the entire length of the skin incision down to the level of the external inguinal ring. In infants and children, it is not extended this far.

III) The external oblique aponeurosis, with its lateral leaf retracted laterally and inferiorly by a forceps, is separated bluntly from the underlying internal oblique muscle to reach the inner aspect of the inguinal ligament. This dissection should not be extended

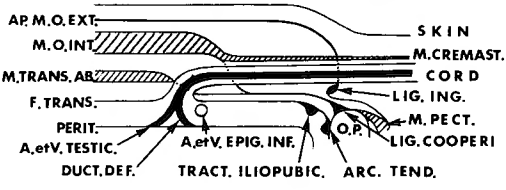


Fig. 5 Diagrammatic representation of the anatomical structures of normal inguinal region. AP. M. O. EXT.; aponeurosis of external oblique muscle M. O. INT.; internal oblique muscle M. CREMAST.; cremaster muscle M. TRANS. AB.; transversus abdominis muscle F. TRANS.; transversalis fascia PERIT.; peritoneum A. et V. TESTIC.; testicular vessels DUCT. DEF.; deferential duct A. et V. EPIG. INF.; inferior epigastric vessels TRACT. ILIOPUBIC.; iliopubic tract ARC. TEND.; tendinous arch O. P.; pubic bone LIG. COOPERI; COOPER's ligement M. PECT.; pectineal muscle LIG. ING.; inguinal ligament.

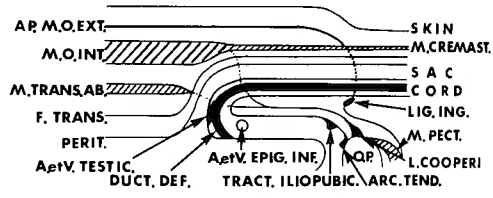


Fig. 6 Diagrammatic representation of indirect inguinal hernia. The hernial sac passes through the internal ring, external to the inferior epigastric vessels, and runs down obliquely through the inguinal canal.

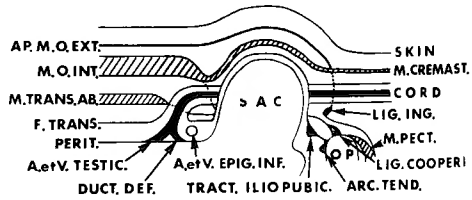


Fig. 7 Diagrammatic representation of direct inguinal hernia. The hernial sac emerges from HESSELBACH's triangle between the inferior epigastric vessels and the edge of the rectus muscle.

* The anatomy of the inguinal region relative to hernia repair has been elaborately studied by many investigators since the early 19th century. But yet there is still a variety of terms used to describe the structures in the inguinal region by anatomists. The nomenclature and interpretation of the inguinal structures are clearer in the descriptions by clinical surgeons. The confusion seems to stem from the wide range of individual variation of structures in the inguinal region, the deformation due to physiological and pathological process and the distorted positions observed during surgery.

Nomenclature of the anatomical structures in the present papar is based upon the report by CONDON, R. E., in "Hernia", 1961, edited by NYHUS, L. M., et al. To help clarify the confusion in nomenclature, some schematic representions of the anatomical structures are included. (Figs. 5, 6, 7)

medially beyond the medial edge of the external oblique aponeurosis, for if it is, unnecessary tissue damage can occur. The spermatic cord runs close to the inguinal ligament and parallel to it. Thus, the Linea SPIEGELI cannot be brought into sight in the operative field during the procedure mentioned above.

IV) Locating the spermatic cord

The spermatic cord, which contains the hernial sac, runs in a superior and lateral to an inferior and medial direction and is covered with the external spermatic fascia, cremaster muscle and internal spermatic fascia. The outermost external spermatic fascia is usually overlooked because of its thinness. Locating the spermatic cord in the cremaster coverage may be difficult when it is searched for blindly, especially in infants in whom the external oblique aponeurosis is not incised sufficiently close to the external inguinal ring to afford a complete view of the related structures. In infants, the best way to locate the white cord is to expose the medial aspect of the inguinal ligament first. Then an opening is made in the cremaster muscle at its lateral aspect through which the white structure is located. During this manipulation, the surgeon must be constantly aware of the anatomical relationship of the cremasteric vessels and the genital branch of the genitofemoral nerve in order not to damage them. The former vessels run on the spermatic cord close to the inner edge of the inguinal ligament (Fig. 8). These vessels and nerve are usually clearly visualized so that they can easily be cut off when accidentally damaged.

V) The spermatic cord is brought into view and bluntly dissected from the surrounding areolar tissue (Fig. 9). This dissection is more easily accomplished if it is not attempted too close to the internal inguinal ring. When the spermatic cord is thoroughly

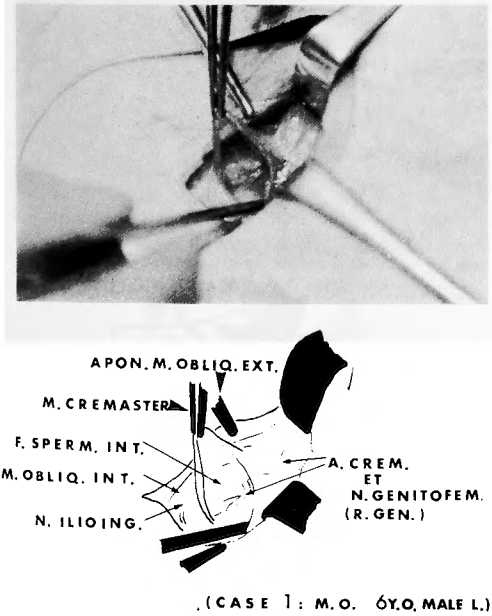


Fig. 8 By opening the cremaster muscle the cremasteric vessels and the genital branch of the genitofemoral nerve can be seen.

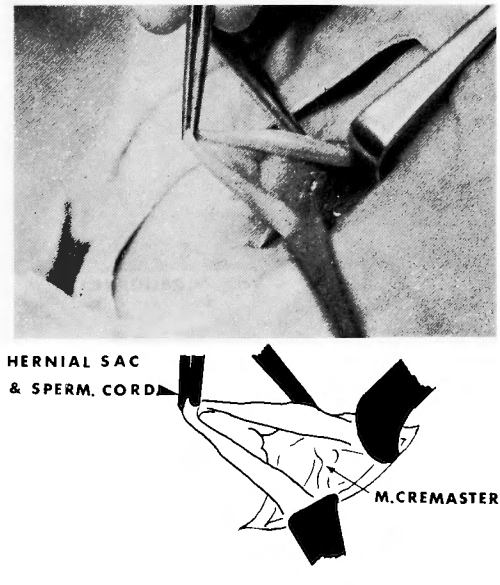


Fig. 9 The spermatic cord with hernial sac is bluntly dissected from the areolar tissue.

exposed, the hernial sac can be seen anteriorly and medially, the internal spermatic vessels posteriorly and laterally, and the Vas deferens behind those vessels through the thin layer of the internal spermatic fascia. Improper handling of the tissues such as distorted traction of the spermatic cord, or poor dissection from the surrounding areolar tissue may displace them enough to make it difficult to locate them.

Dissection of the hernial sac from the internal spermatic vessels can be performed with less difficulty by the infiltration of a few cc's of saline or 5% glucose solution into the areolar tissue between the sac and the internal spermatic vessels while grasping the hernial sac with a hemostat (Fig. 10). The use of saline or 5% glucose solution will also be of help in dissecting the spermatic cord free from the wall of the hernial sac.

The deferentialis artery which runs on the spermatic cord should be handled carefully for damage can result in post-operative hematomal formation. After the hernial sac has been isolated, the whole internal inguinal ring can be seen by tightly pulling the separated sac laterally and superiorly with a hemostat and retractors respectively. The internal spermatic fascia joins the transversalis fascia near the internal inguinal ring. The anatomical relationship of the internal inguinal ring should be determined at this stage because it becomes obscure due to capillary oozing after another manipulation. The size may be roughly judged from both the size of the hernial sac at its neck and the course of the inferior epigastric vessels. In general, the inferior epigastric vessels run upward encompassing the internal inguinal ring when the internal inguinal ring is relatively narrow, but it tends to arch toward HESSELBACH's triangle as the internal inguinal ring becomes dilated

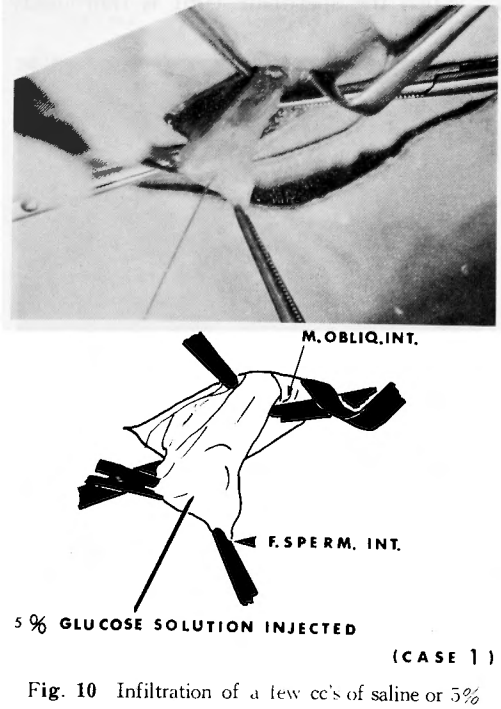


Fig. 10 Infiltration of a few cc's of saline or 5% glucose solution between the hernial sac and the spermatic cord.

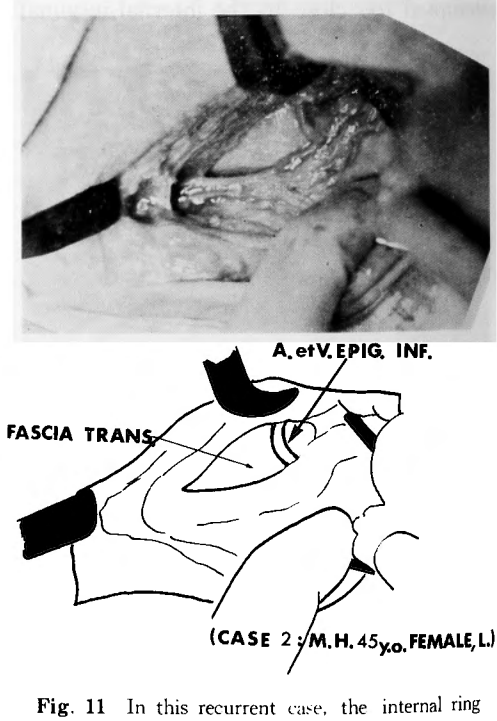


Fig. 11 In this recurrent case, the internal ring is so dilated that the inferior epigastric vessels arch toward HESSELBACH's triangle.

(Fig. 11). In addition, HESSELBACH's triangle is usually poorly formed if the internal inguinal ring is wide open.

VI) The operative method chosen depends upon the age of the patient, the size of the internal hernia ring and other factors. The criteria we use for selecting the operative method for each type of case and the critical features of the method will now be presented.

A. Infants under the age of one year with a narrow internal hernia ring; The hernial sac is carefully inspected to determine its contents and if necessary an opening is made in it. Then the sac is separated free from the spermatic cord and internal spermatic vessels upward until the pyramidal shaped retroperitoneal fat which is attached to the hernial sac is brought into view (SNYDER and others refer to this portion of the hernial sac as its neck). The fat pad is retracted with a forceps, and the sac is ligated and divided as high at its neck as possible so as not to leave any residual peritoneal protrusion (Figs. 12, 13). The divided hernial sac is incised longitudinally selecting a point where there are few vessels so as to limit post-operative fluid collection. Hemostasis must be completed with meticulous care The divided hernial sac is returned to the pre-operative site to prevent elevation of the testicle. This can easily be done under the guide of a hemostat The internal oblique muscle and cremater muscle are returned to their ordinary position. The external oblique aponeurosis is approximated together with fine No. 3 silk sutures. Kanalnaht or Pheilnaht, as described by HATAKOSHIS, are not used by us.

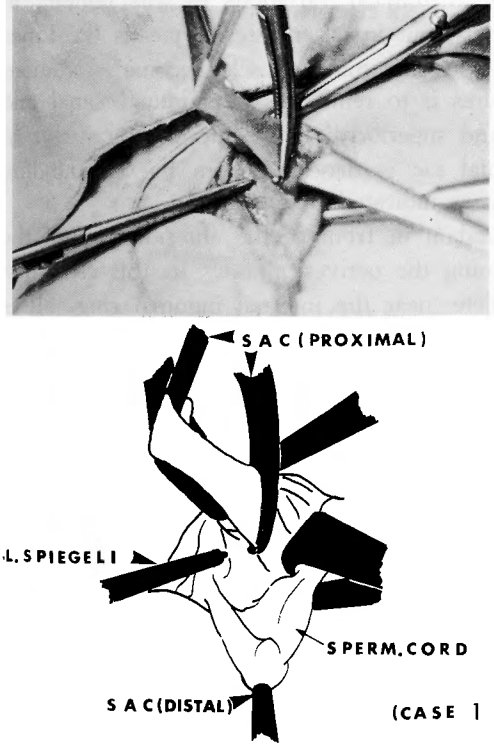


Fig. 12 The hernial sac is grasped high at its neck.

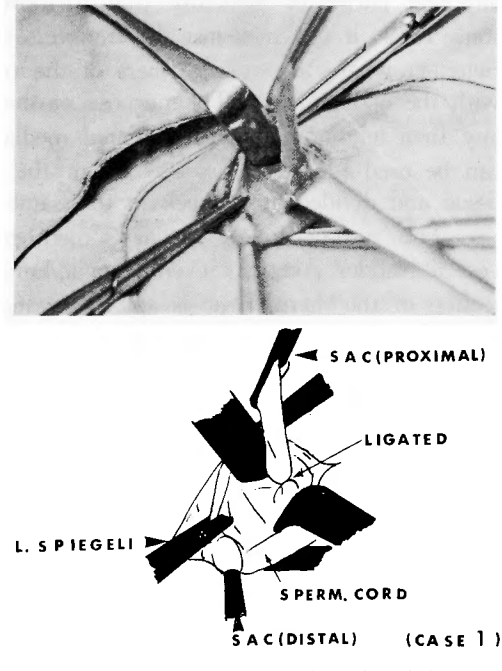


Fig. 13 The hernial sac is ligated and divided as high at its neck as possible.

Both subcutaneous fat tissue and superficialis fascia are sutured together. The superficial areolar tissue is sutured together directly beneath the skin to facilitate skin closure. The skin is closed with fine catgut subcuticular sutures. This method is diagramatically depicted in Fig. 14.

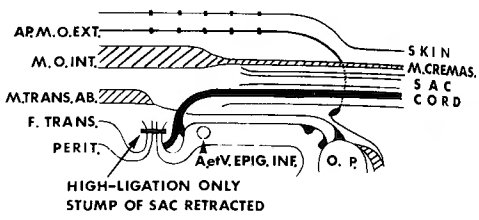


Fig. 14 Diagrammatic representation of inguinal hernia repair for infants under the age of one year, with a narrow internal ring. Only high ligation of the sac performed.

The wound is covered with collodion dressing which is left in place for five days.

A gastrointestinal catheter, which is routinely inserted under general anesthesia, is removed as soon as the patient awakens after surgery. The post-operative nutritional care given is in accord with the general principles of pediatric surgery. Ircodin suppositorium, one-third of the adult dose, is given per rectum to eliminate post-operative pain. Antibiotics are administered only if infection is inevitable, which is a rare occurrence.

B. Infants with a dilated internal hernia ring, poorly formed HESSELBACH's *triangle, or children under six years of age with an arrow internal inguinal ring*: The internal hernia ring is exposed and brought into sight as mentioned in (V). Any firm "tendinous structure" which lies medially and superiorly to the internal inguinal ring is grasped with hemostats at two points. The term "tendinous structure" does not necessarily imply any one particular structure due to individual anatomical variations in this region; in some cases, it indicates just the transversalis fascia, but in other cases it means the Linea SPIEGELI where the muscle fibers of the transversus abdominis muscle become continuous with the aponeurosis. The purpose of the sutures is to reinforce the inguinal canal and any firm tendinous structure located medially and superiorly to the internal inguinal ring can be used for this purpose. Then the hernial sac is dissected from the surrounding tissue and divided at its neck in the same way as indicated in section A.

The retroperitoneal fat is sometimes abundant in front of the anterior wall of the vesical bladder and may even form a lump joining the perivesical fat. In this case, dissection of the hernial sac is apt to be incomplete near the internal inguinal ring. It is important for the neck of the hernial sac to be dissected as high as possible; neck ligation should be regularly performed at the level of the inferior epigastric vessels and as close to those vessels as possible on the plane of the transversalis fascia. The neck of the hernial sac may be separated with less trouble by sharp dissection with scissors.

In most cases, the hernial sac is ligated and separated without any danger.

Some surgeons routinely open the hernial sac and infiltrate saline or 5% glucose solution beneath the preperitoneum and separate the hernia sac, as a mere sheet of peritoneum, free from the internal spermatic fascia. We only use this technique if there is particular difficulty in separating the spermatic cord and internal spermatic vessels from the peritoneum because this technique sometimes creates problems in the hernia repair of babies. The peritoneum of babies is extremely thin and friable and once torn the surgical procedure becomes more difficult and the prognosis for complete repair becomes poorer. It is thus, far safer to ligate and divide the hernial sac without separating it from the internal spermatic fascia. Adequate high ligation and division of the hernial sac permits

the centrally cut end of the peritoneum to automatically fall deep below the plane of the transversalis fascia, eliminating any protrusion of the peritoneum (Fig. 15).

The portion of the internal oblique muscle that will be joined to the inguinal ligament is retracted laterally and inferiorly with a retractor and then the iliopubic tract, (grasped medially to the internal oblique muscle (Fig. 16)) and the Linea SPIEGELI, or the tendinous portion of the transversalis fascia, are approximated with two interrupted sutures just above the internal inguinal ring, to strengthen the internal inguinal ring. This method is diagrammatically depicted in Fig. 17. Additional sutures may be placed distal

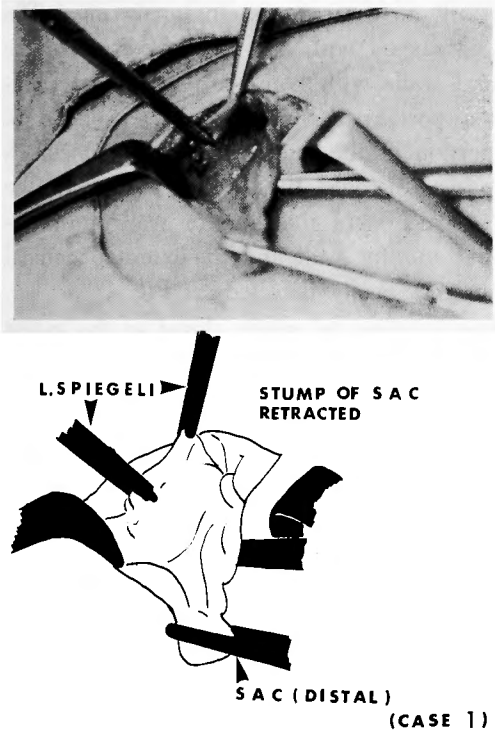


Fig. 15 The centrally cut end of the hernial sac falls deep below the plane of the transversalis fascia.

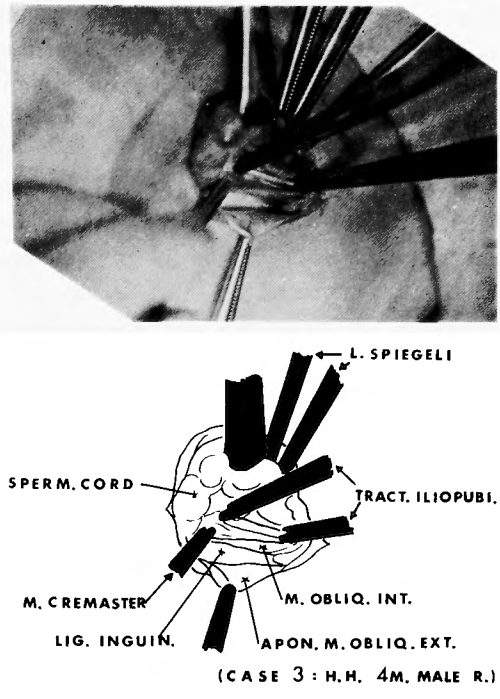


Fig. 16 The iliopubic tract is grasped medial to the insertion of the internal oblique muscle to the inguinal ligament.

to it according to the width of the internal inguinal ring. Sometimes the iliopubic tract is not strong enough for use in hernia repairs. In such cases repair may be carried out using the inguinal ligament instead of the iliopubic tract. Care should be taken to avoid damage to the inferior epigastric vessels during this procedure. This method is used in 30-40% of cases of hernia repair in our practice.

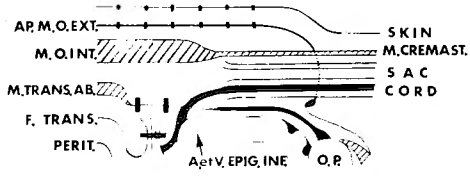


Fig. 17 Diagrammatic representation of inguinal hernia repair for infants with a dilated internal ring and poorly formed HESSELBACH's triangle, or children under six years of age with a narrow internal ring. Two or three sutures are placed above the internal ring.

C. Chidren under six years of age with a dilated internal inguinal ring or an underdeveloped HESSELBACH's *triangle, or adults with a narrow internal inguinal ring*: The ligation and isolation of the hernial sac is performed as indicated in section B. In the cases categorized in this section, however, reinforcement of the internal inguinal ring is more important than in the cases in section B.

Approximation of the iliopublic tract to the Linea SPIEGELI or the aponeurotic arch of transversus abdominis should be extended sufficiently caudal (Figs. 18, 19.) Herniorrhaphy is performed over the entire length of the inguinal canal, the external oblique aponeurosis is incised downward to the external inguinal ring and the cremaster muscle, and is incised from its site at the opening medially and inferiorly to the external inguinal ring. The posterior wall of the inguinal canal is, thus, reconstructed with the middle portion of the HESSELBACH,s triangle; and its anterior and lateral walls with both the iliopubic tract (including the underlying COOPER's ligament) and a portion of the transversus aponeurosis. The conjoint tendon (junction of the caudal portion of the internal oblique aponeurosis and transversus aponeurosis which sometimes consists of only the caudal portion of the internal oblique aponeurosis) is utilized for reconstruction of the anterior wall of the inguinal canal. This results in strengthening of the anterior wall and the external inguinal ring of the inguinal canal. This method is diagrammatically depicted in Fig. 20.

It is our impression that the external inguinal ring can be safely closed to the extent that there is barely room for the tip of a hemostat. (There has been a difference in opinion concerning the extent to which the external inguinal ring can be closed without compromising the blood supply to the testicle. This problem will be dealt with later).

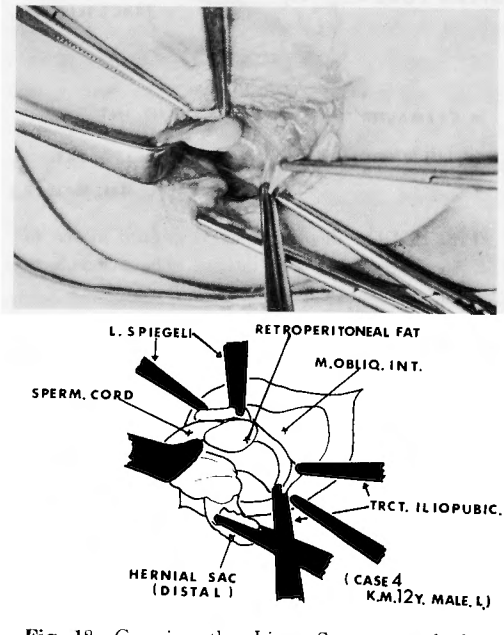


Fig. 18 Grasping the Linea SPIEGELI and the iliopubic tract permits the pyramidal shaped retroperitoneal fat to be brought into view.

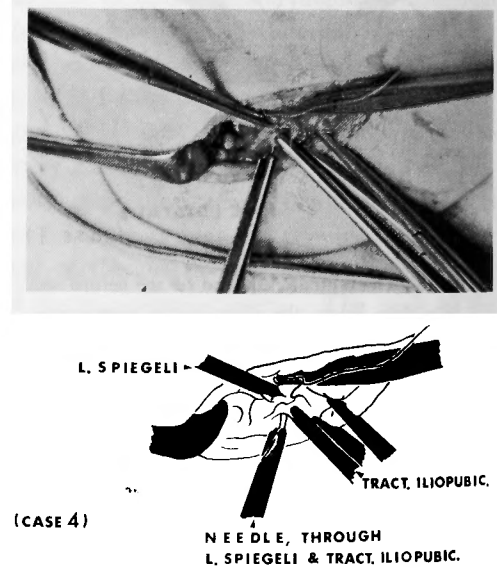


Fig. 19 Approximation of the iliopubic tract to the Linea SPIEGELI. This should be extended sufficiently caudad.

We have frequently encountered patients in whom failure to close the external inguinal ring sufficiently as in the original HATAKOSHI method is presumably the cause of a recurrence of the hernia post-operatively. This has led us to reconstruct the external inguinal ring in our modified method to the size mentioned above.

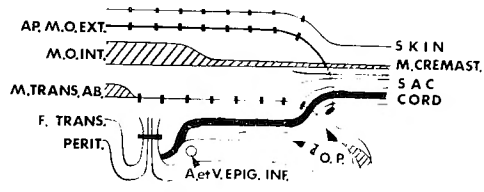


Fig. 20 Diagrammatic representation of inguinal hernia repair for children under six years of age with a dilated internal ring and an underdeveloped HESSELBACH's triangle, or adults with a narrow internal ring. Approximation of the iliopubic tract to Linea SPIEGELI or the aponeurotic arch of transversus abdominis should be extended caudal.

It is worth bearing in mind that all of the maneuvers used in the reconstruction of the anterior wall of the inguinal canal are performed beneath the cremaster muscle (Fig. 21), where accidental injury to the tissues and vessels is minimized.

Following reconstruction of the inguinal canal, the cut edges of the cremaster muscle are restored to their proper position (suturing is optional). The internal oblique muscle is also restored to its proper position. In the event that the internal oblique muscle is poorly formed or inserts into the outer edge of the rectus sheath instead of the pubic tubercle, the so-called "shutter action" of the internal oblique muscle is not expected to work effectively. In such cases, it is advisable to approximate the internal oblique muscle to the inguinal ligament with a couple of sutures.

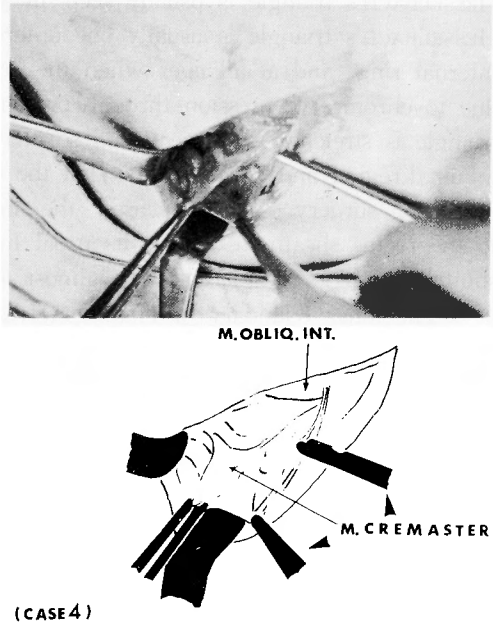


Fig. 21 All of the maneuvers are performed beneath the cremaster muscle, then its cut edges should be restored to their proper position.

It is our impression that reconstruction of the external inguinal ring in the external oblique aponeurosis (described by HATAKOSHI) does not serve as a means of reinforcement. When the external oblique aponeurosis is very slack, oversuture is applicable; the cut edge of its lateral flap is sewed to the undersurface of the medial flap and that of the medial flap to the uppersurface of the lateral flap. To pile up these flaps in the reverse manner may embroil the ilioinguinal nerve in the suture line because the nerve often adheres to the undersurface of the medial flap of the external oblique aponeurosis.

Collateral blood supply* to the testicle is through the superficial fat and areolar tissue around the external inguinal ring and it is well established that this blood supply is sufficient to protect the testicle from atrophy even when its main blood supply is reduced greatly or even completely restricted within the inguinal canal. Interruption of this col-

* Such collateral blood supply is considered to be by way of the subcutaneous tissue distal to the external inguinal ring, although it still remains to be confirmed.

lateral blood supply is incidental to part of the original HATAKOSHI technique, (the external inguinal ring is handled with the external oblique aponeurosis) and predisposes to the development of post-operative atrophy of the testicle. Post-operative atrophy is inevitable if the main blood supply is also compromised within the inguinal canal. Such post-operative atrophy of the testicle is not associated with our technique for hernia repair, even if the conjoint tendon and the iliopubic tract are tightly closed. It is, however, not rare in cases treated by other techniques, such as in those in which the external inguinal ring is reconstructed by suturing the external oblique aponeurosis as in the original HATAKOSHI method. We do not agree with the practice of utilizing the external oblique aponeurosis for the reconstruction of the external inguinal ring in any case.

D. Young adults with a dilated internal inguinal ring or a poorly formed HESSELBACH's *triangle and all middle-aged or aged patients*: Underdevelopment of HESSELBACH's triangle is usually seen in young adults. On the other hand, atrophy of HESSELBACH's triangle is usually encountered in aged patients associated with an enlarged internal ring, and at all ages when the entire structure in the inguinal region is atrophic due to chronic compression through prolonged wearing of a hernia bandage. HESSELBACH's triangle is stretched and weakened so that the hernia is seen as a broad hill over the inguinal region and so attenuated that the structures beneath it are sometimes seen through it during surgery. In such cases, the internal oblique muscle is often seen attached to the rectus sheath instead of its usual insertion onto the pubic tubercle, and the muscle's shutter action is considered to be almost totally lost (LAMPE, E. W.).

The inner boundary of HESSELBACH's triangle, delineated by the Linea SPIEGELI, the arch of the transversus aponeurosis and the conjoint tendon, is sutured to the iliopubic tract in the same way as mentioned in section C, although transplantation of the spermatic cord as in Bassini's method is necessary in patients of this group. The HESSELBACH's triangle must be completely closed in patients of this group for the prevention of post-operative direct hernia, because the unclosed caudal area is the usual site of post-operative herniation (Figs. 22, 23). The lowermost portion of the conjoint tendon, or the rectus sheath when the conjoint tendon is not available, is usually sutured to the lowermost portion of the iliopubic tract. In the aged or female patient, COOPER's ligament, deep beneath the iliopubic tract, is sutured to the

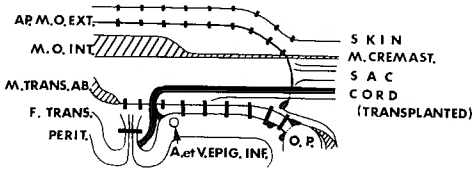


Fig. 22 Diagrammatic representation of inguinal hernia repair for young adults with a dilated internal ring and poorly formed HESSELBACH's triangle, and all middle aged and aged patients. Transplantation of the spermatic cord and reinforcement of the posterior wall.

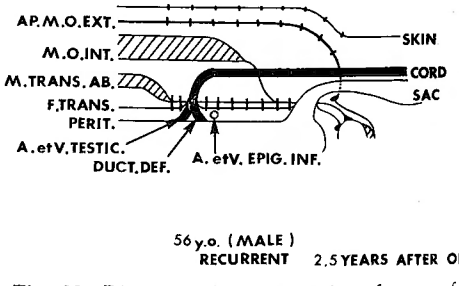


Fig. 23 Diagrammatic representation of a case of recurrent inguinal hernia. In the previous operation, the spermatic cord had been transplanted and the posterior wall had been reconstructed incompletely. Postoperative hernial sac emerges through the most caudal gap of new posterior wall.

conjoint tendon at its insertion to the pubic tubercle (the rectus sheath or tissues nearby are substituted when the conjoint tendon is not found at this location) to strengthen the floor. The new internal ring should be narrowed with interrupted sutures placed around the spermatic cord (Fig. 24). Tight narrowing of this portion is not accompanied by post-operative atrophy of the testicle as mentioned before. It is well known clinically and experimentally that the rate of occurrence of the testicular atrophy is lower as the spermatic cord is divided more cephalad. Our experience also supports this. In case the structures which correspond to the HESSELBACH's triangle are attenuated, the technique outlined in section C is not suitable because the floor of the inguinal canal, which consists of the transversalis fascia and peritoneum, is too thin and weak and practically unavailable for use in narrowing the inguinal canal. That is, the reconstructed canal will not remain narrow in that the posterior wall can stretch irrespective of the degree or type of reinforcement of the anterior wall. It is evident that reinforcement using such an unsuitable structure will account for the recurrence of either direct or indirect hernia. To prevent recurrent hernia the posterior wall of the canal must be reinforced firmly from the level above the internal inguinal ring down to the pubic tubercle. However, strengthening of the anterior wall of the canal can be accomplished by simply approximating the internal oblique muscle to the inguinal ligament. "Pheilnaht" or pile suture may be additionally placed in the external oblique aponeurosis.

E. Aged patients with weakened structures in the inguinal region, case of complicated or recurrent hernias: In cases of aged patients, recurrent or direct hernias, some radical repairs are necessary. The preperitoneal techniques are also useful in this group to avoid the recurrence as in other groups. However, in this treatment some points must ed emphasized. A relaxing incision must often be made in the anterior sheath of the rectus muscle for the purpose of reducing the tension produced by intensive reconstruction of the floor of the inguinal canal (Fig. 25). The hernia sac has to be ligated high at the peritoneum itself (it does not have to be ligated together with transversalis fascia as in method D). No matter how well the operation may otherwise be done, tissue deficiencies or weakness often cause them to recur unless such as Teflon mesh is used to suppy the locus minoris. The posterior wall of the canal is reinforced over its entire length with Teflon mesh to strengthen the fascia, preperitoneally or beneath the transversalis fascia, suturing it between the rear of the transversus abdominis muscle and the line of the iliopubic tract to COOPER's ligament. More Teflon mesh is often placed beneath

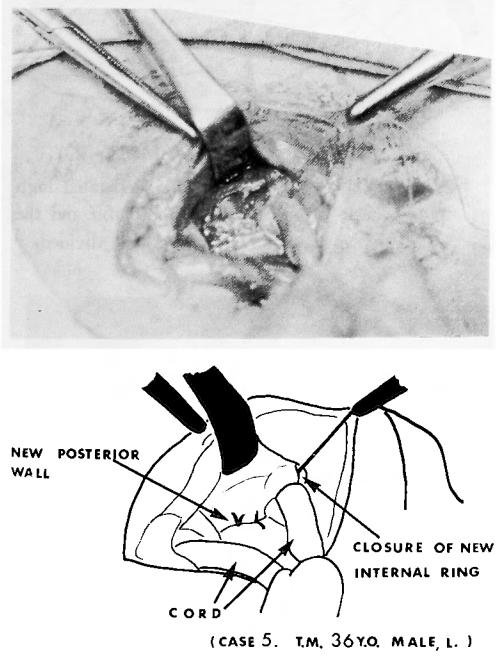


Fig. 24 Around the spermatic cord, the new internal ring should be tightly narrowed.

the sutured external oblique muscle. In Figs. 26-35 examples of those techniques are shown.

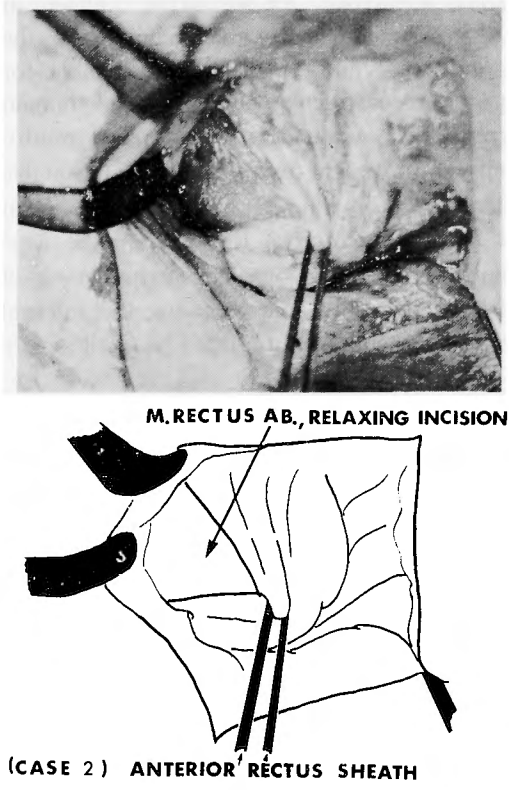


Fig. 25 Relaxing incision is necessary in order to reduce the tension. This patient wore a hernia bandage for such a long time that the structures of the inguinal canal are weakened.

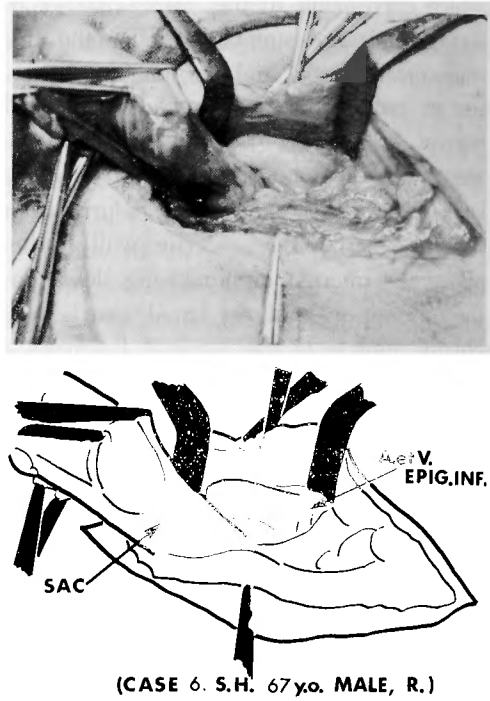


Fig. 26 The hernia sac should be separated high at its neck from the preperitoneal fat and the other areolar tissue, then ligated and divided.

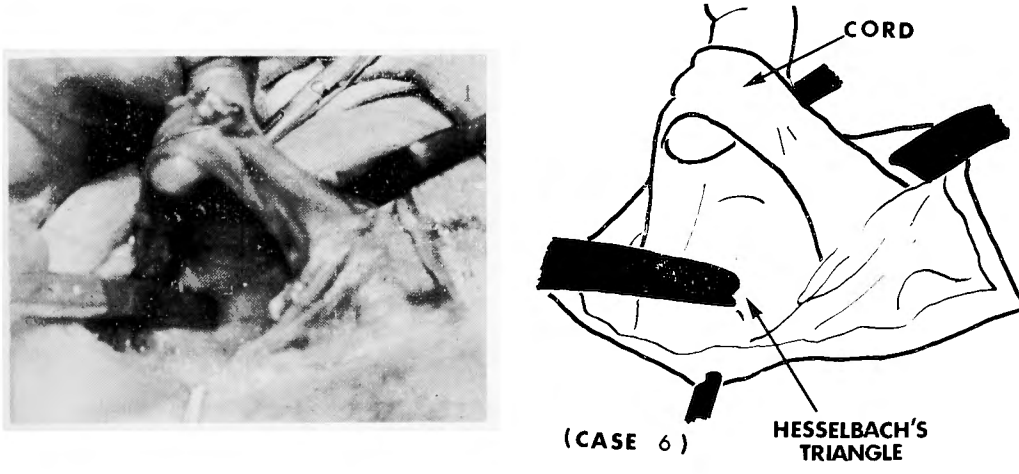


Fig. 27 The strength of HESSELBACH's triangle should be determined. When it is weak and the other structures of the inguinal canal are poorly formed, some type of prostheses is necessary.

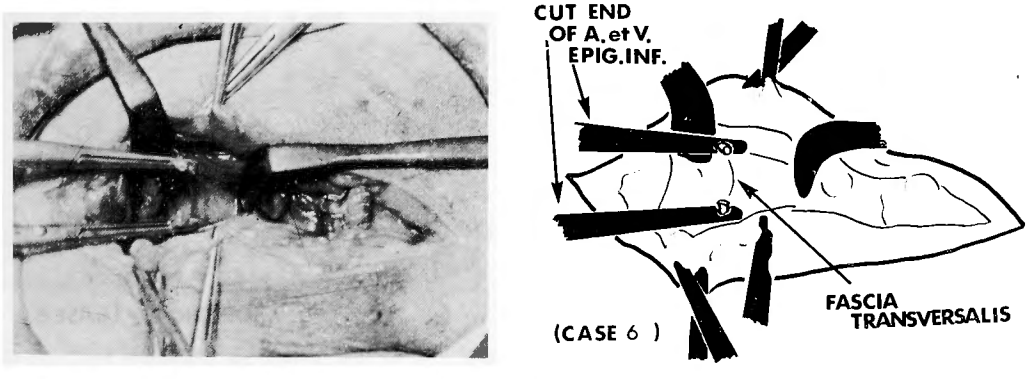


Fig. 28 If a prosthesis is indicated, the inferior epigastric vessels should be cut off and the prosthesis inserted. We usually use Teflon mesh as prosthesis.

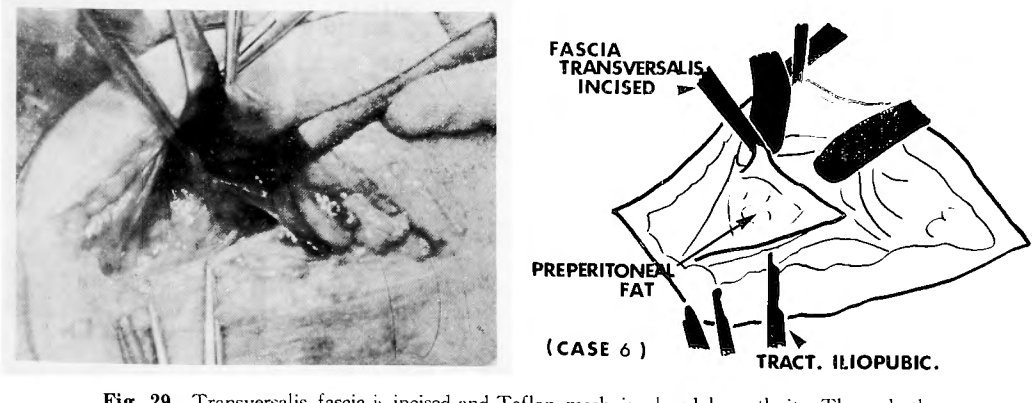
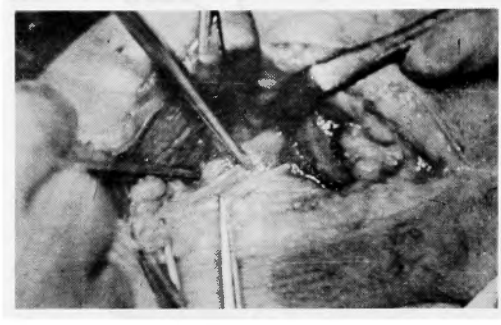


Fig. 29 Transversalis fascia is incised and Teflon mesh is placed beneath it. Through the opening of the transversalis fascia, the preperitoneal fat can be seen.



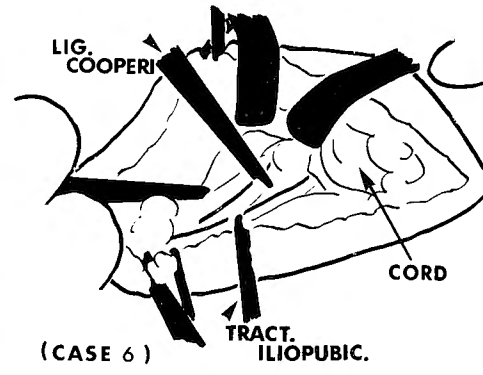
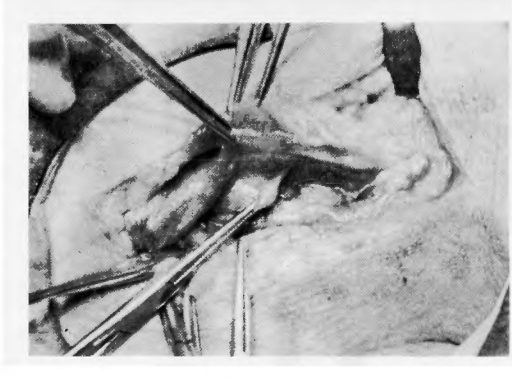


Fig. 30 The iliopubic tract and the Cooper's ligament are grasped, showing their anatomical relationship. Teflon mesh is sutured to them inferiorly.



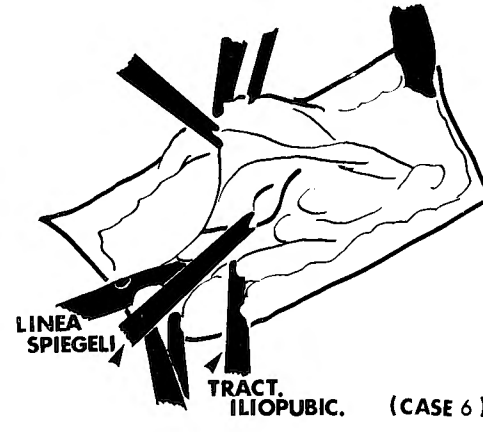
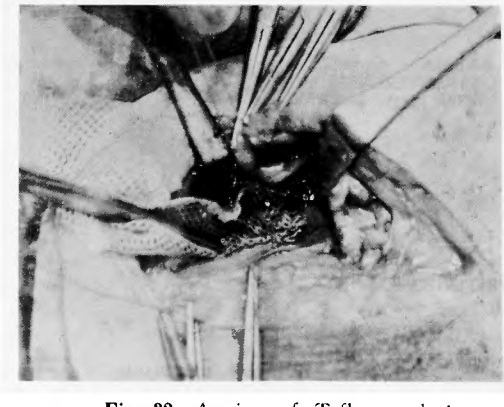


Fig. 31 The Linea Spiegeli or the aponeurotic arch of the transversus abdominis is grasped. Teflon mesh is sutured superiorly to them.



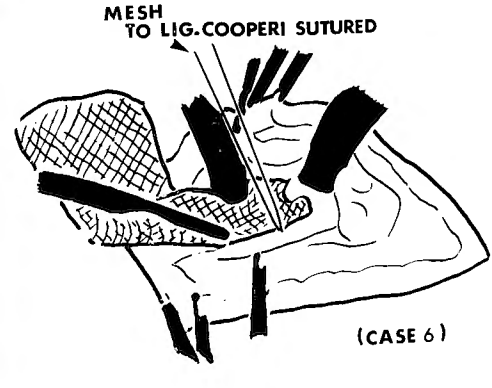


Fig. 32 A piece of Teflon mesh is sutured to Cooper's ligament close to the pubic tubercle, beneath the transversalis fascia.

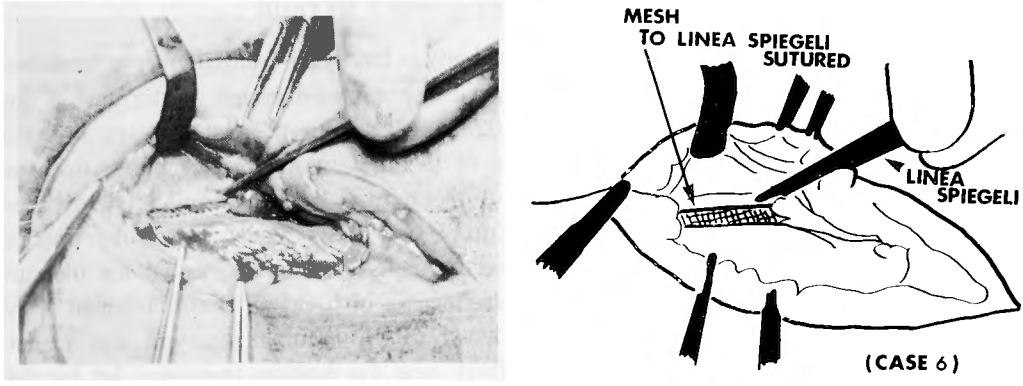


Fig. 33 Teflon mesh is sutured to the Linea Spiegeli or aponeurotic arch of transversus abdominis. At the most lateral end, mesh is also sutured to the inguinal ligament.

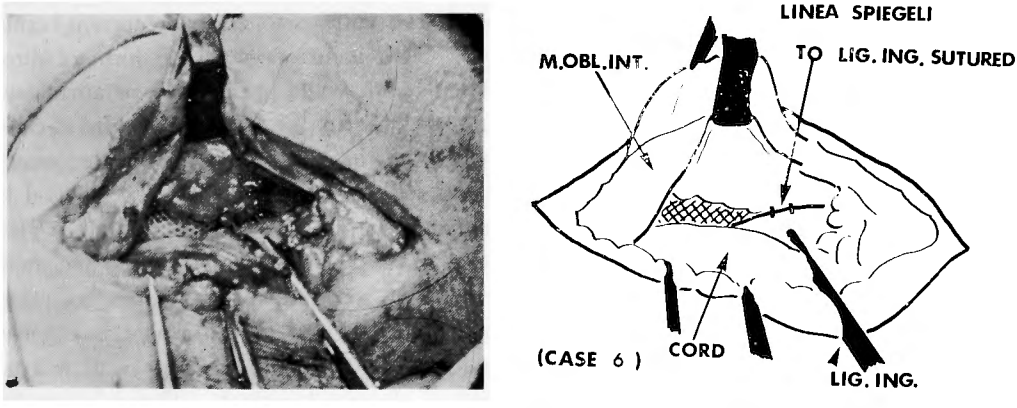


Fig. 34 Above the sutured mesh, the Linea Spiegeli or the aponeurotic arch of the transversus abdominis is approximated to the inguinal ligament.

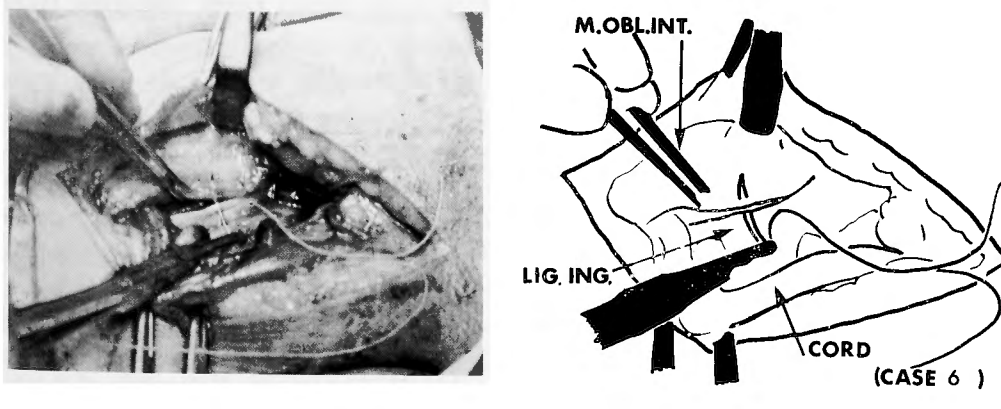


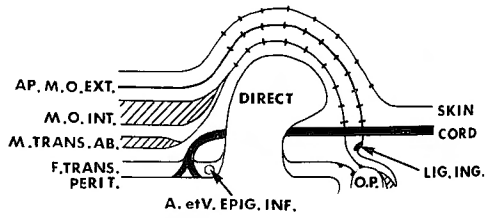
Fig. 35 A relaxing incision is made in the anterior rectus sheath (Fig. 25). Then the internal oblique muscle is approximated to the inguinal ligament. If necessary, the second prosthesis may be placed over the entire area, including the relaxing incision.

III. EVALUATION OF HATAKOSHI'S METHOD

The HATAKOSHI technique for the cure of hernias has been utilized over a period of 35 years in our hospital. Based upon our experiences gained through performing a few thousand cases of hernia repair, including 1024 cases during the last 4 years, it is our belief that his procedure is unquestionably one of the best in the history of treatment of hernias. Fifty years ago, when extirpation of the hernial sac was considered to be essential in the cure of hernias particularly in Europe and the United States of America. HATAKOSHI felt that the removal of the divided hernial sac was not essential for the cure of hernias and proved his hypothesis in a hundred cases of hernias. Reinforcement of the internal hernia ring by suturing the Linea SPIEGELI to the inguinal ligament was an outstanding idea at that time when BASSINI's method was the leading treatment for hernias. His approval of FERGUSON's technique, who established non-cord transplantation method in 1899, has special significance in that he intended it to be a simpler hernia repair technique.

Despite its unquestioned value, we have been faced with postoperative recurrent hernias even in cases treated by the HATAKOSHI method. Such recurrences in the form of direct hernias are more likely to occur in the aged patients and would presumably be attributable to incomplete reinforcement of the HESSELBACH's triangle in his technique. His so-called "Pfortnaht" and "Kanalnaht" using the aponeurosis of the external oblique muscle may not prevent the development of a post-operative recurrent hernia. It is advised by HATAKOSHI, in such cases, to extend the "Pfortnaht" enough caudally to strengthen HESSELBACH's triangle, the usual site of post-operative direct hernia. This suture line, however, cannot be extended to the point that the canal is so narrow that it does not afford room for the spermatic cord structures. Unfortunately, even if the Pfortnaht is extended well distally, the weakened HESSELBACH's triangle or the atrophic posterior wall will not be adequate to handle the abdominal pressure in the aged patient. The reconstructed canal becomes weakened sooner or later and provides a site for the recurrence of direct hernias. (diagrammatically shown in Fig. 36).

Recurrence of indirect hernia has been encountered, though rarely following HATAKOSHI's technique. Recurrent indirect hernia can develop as a result of the reconstructed canal stretching the atrophic posterior wall (Fig. 37), or the incomplete "high ligation" (Fig. 38). It is important, therefore, to strengthen the posterior wall of the inguinal canal over its entire length. In our practice, this strengthening has been accomplished by suturing the Linea SPIEGELI, aponeurosis of the transversus abdominis or the conjoint tendon to the iliopubic tract or COOPER's ligament. Occasionally, the so-called cord transplantation technique such as described by BASSINI is considered to be the method of



2 CASES: S.M. 4 y.o. (MALE)
B.U. 75 y.o. (MALE)

Fig. 36 Diagrammatic representation of a type of recurrent hernia. The previous operation is concluded to be similar to HATAKOSHI method. The weakened HESSELBACH's triangle provides a site for the recurrence of direct hernia.

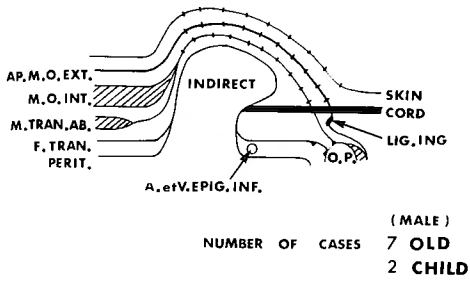


Fig. 37 Diagrammatic representation of a type of recurrent hernia. The previous operation is concluded to be similar to HATAKOSHI method. The atrophic posterior wall and the dilated internal ring are the causes of recurrence of indirect hernia.

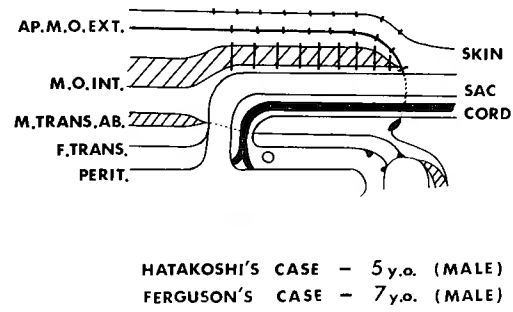


Fig. 38 Diagrammatic representation of a type of recurrent hernia. The previous operation is concluded to be similar to HATAKOSHI method. But because of incomplete high ligation, the protrusion of peritoneum provides the site for the recurrence of indirect hernia.

choice. Fortunately, the Teflon mesh prosthesis is rarely needed in the repair of hernias in Japanese subjects because their HESSELBACH's triangle is relatively well developed.

IV. USE OF "HATAKOSHI METHOD" IN JAPAN

Few surgeons follow the original HATAKOSHI technique forthright in the treatment of hernias but many others refer to their techniques as the conventional HATAKOSHI method, the authentic HATAKOSHI method having been modified. It is justifiable for a surgeon based upon his experiences to develop his own technique through modification of established techniques. The introduction of a variety of modifications of HATAKOSHI method, however, makes it difficult to conduct a statistical analysis of the "HATAKOSHI method" for hernia repair. A survey by IKEDA in 1967 (Table 1), which included data from 82 hospitals all over Japan including university hospitals, shows that the HATAKOSHI method is used exclusively for all cases of the inguinal hernia repair in 7 hospitals and selectively for cases in the other hospitals. These figures give the impression that the HATAKOSHI method is the preferred technique for hernia repair. But it is doubtful that Dr. HATAKOSHI would recognize some of the techniques as his own. For example, here is one example of the so called HATAKOSHI method which is currently practiced by surgeons of Kyoto University Hospital. The details of the technique as presented in Geka Chiryo (Journal of surgical therapy for practitioners in Japan) by A. AOYAGI, emeritus professor of Kyoto University, are as follows;

Table 1 Methods of Operation
(82 Hospitals in Japan)

Method	Adopted	(Entirely)
LUCAS-CHAMPIONNIERE	28	(2)
CZERNY	20	(0)
FERGUSON	55	(15)
HATAKOSHI	16	(7)
BASSINI	45	(5)
the others	4	(0)
KOCHER	2	
KIMOTO	1	
ZIMMERMAN	1	

: IKEDA, K. : Gekachiryo, 16, 652, 1967

1) The hernial sac is ligated and divided at its neck in the area of the internal inguinal ring (Fig. 39).

2) The hernial sac distal to it is left in situ.

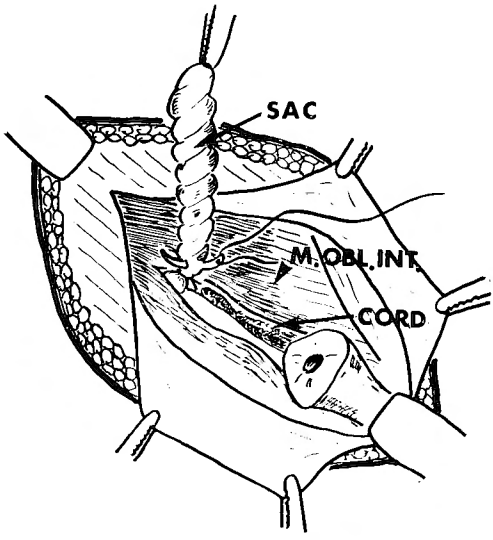


Fig. 39 The hernial sac is twisted, and then is ligated and divided at its neck. (Y. AOYAGI, Geka Chiryo, 1967)

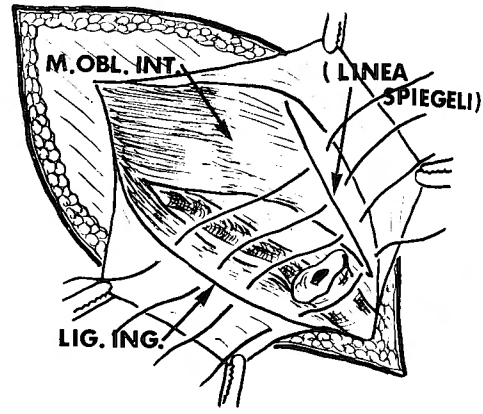


Fig. 40 Approximation of the portion of the aponeurosis where the internal oblique aponeurosis joins the anterior rectus sheath to the inguinal ligament. (Y. AOYAGI, Geka Chiryo, 1967) (LINEA SPIEGELI misinterpreted.)

3) The medial cut edge of the external oblique aponeurosis is retracted upward to expose the tendinous line of junction of the internal oblique aponeurosis and the rectus sheath* from above. This tendinous portion is sutured to the rear aspect of the inguinal ligament with some interrupted stitches (Fig. 40). The suture line is extended downward from the level of the internal inguinal ring and the suture is placed between the inguinal ligament at its portion 1-2 cm lateral to pubic tubercle and the outer edge of the rectus sheath 2-3 cm superior to pubic symphisis so that the external ring barely allows the little finger tip to pass through.

4) Pfeilnaht, or the Kanalnaht in the KOCHER method, is then performed. AOYAGI mentions that this procedure is able to be substituted by approximating either edge of the fascia together with interrupted sutures. In this procedure an important feature of the original HATAKOSHI method is not strictly adhered to, but is modified for prevention of postoperative recurrent hernia. This is one of several techniques for hernia repair used by surgeons of Kyoto University Hospital over the last 35 years. AOYAGI states that recurrence is not likely to be associated with their technique if all of the steps in the procedure are adhered to. Conclusively the modified HATAKOSHI method which is practiced at Kyoto University Hospital is even further unduly simplified by many surgeons. Their techniques are quite apart in their precepts of the hernia repair from that which should be in the modern era of hernia surgery.

* The structure which is seen during this procedure and referred to by the surgeons of Kyoto University Hospital as the Linea SPIEGELI is not the anatomically true Linea SPIEGELI but is the portion of the aponeurosis where the internal oblique aponeurosis joins the rectus sheath. The anatomically true Linea SPIEGELI can not be brought into sight from the outerside of the internal oblique muscle but can be seen only by retracting the internal oblique muscle, because it is "the line of junction of the muscle fibers and aponeurosis of the transversus abdominis" (DOLLAND).

In reviewing the techniques of various practitioners we have visited, we frequntly find that their so called HATAKOSHI method is quite different from the authentic HATAKOSHI technique. They do not seem to be concerned about the site at which ligation and division of the hernial sac is performed but have misinterpreted the purpose of the original technique and have assumed it to be one of mere non-cord transplantation. The internal oblique aponeurosis instead of the Linea SPIEGELI or the internal oblique muscle itself is variously approximated to the inguinal ligament. This does not accomplish a reinforcement of the inguinal canal. Yet it is surprising to find that surgeons are satisfied with this incomplete technique. Another technique which is frequently observed consists of making a skin incision 6 cm long centered over the area of the external inguinal ring, the external oblique aponeurosis is incised downward toward the external inguinal ring, then the divided peritoneal edge is dissected cranially a little bit and ligated there without reaching the neck of the sac or the level of the inferior epigastric vessels. Reinforcement of the inguinal canal is completed simply by suturing the inferior edge of the internal oblique muscle to the inguinal ligament and then by placing Pfeilnaht or folding the external oblique aponeurosis. This method is also misconceived to be the HATAKOSHI method in Japan.

Such incomplete techniques, though, are not necessarily accompanied by recurrences but actually permanently cure the vast majority of cases. They are, however, supposedly responsible for the continuing high incidence of recurrent hernia for the last 40-50 years in Japan. There has been a recent decrease in the rate of recurrence in England and America where attention is focused upon the high ligation and the deep structural reconstruction on the peritoneal level in the inguinal canal for the strengthening of it (Figs. 41, 42).

The high incidence of recurrence following the HATAKOSHI method is not attributable to the original HATAKOSHI method itself but to the so called HATAKOSHI methods. That is because the statistics probably includes many cases treated by the latter method under the name of the former. For instance, we often encounter the extreme case; in which the only similarity between the HATAKOSHI method and what was done is that there is an incision in the skin and external oblique muscle.

It is also a fact that some surgeons classify hernia repair techniques into two groups, of cord transplantation and non-cord transplantation. HATAKOSHI technique is roughly classified in the latter group. It is almost impossible to expect such surgeons to reliably appraise their operative technique since it is based upon incomplete awareness of the basic feature of the HATAKOSHI procedure.

We repair about 250 hernias every year (274 in 1966, 239 in 1965, 266 in 1964 and 245 in 1963). This includes about 10-20 cases of recurrent hernia every year which were operated originally by other surgeons. In half of those recurent cases the previous technique was concluded to be similar to the so called or convenient HATAKOSHI method.

In the last year we experienced 8 cases of recurrent hernias (5 in elderly patients and 3 in infants) in which their previous operations by other surgeons were inferred to have been by the so called HATAKOSHI method. These constituted one half of the recurrent hernias in our hospital. The recurrent hernia was found through the internal inguinal ring in 7 cases and as a direct hernia in one case of a 4 years old male. In 6 of 7 cases

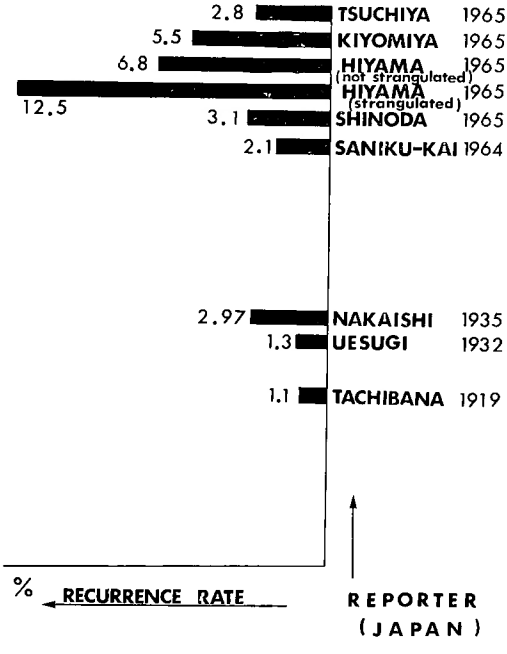


Fig. 41 Recurrence rate of the inguinal hernia repair, reported in Japan.

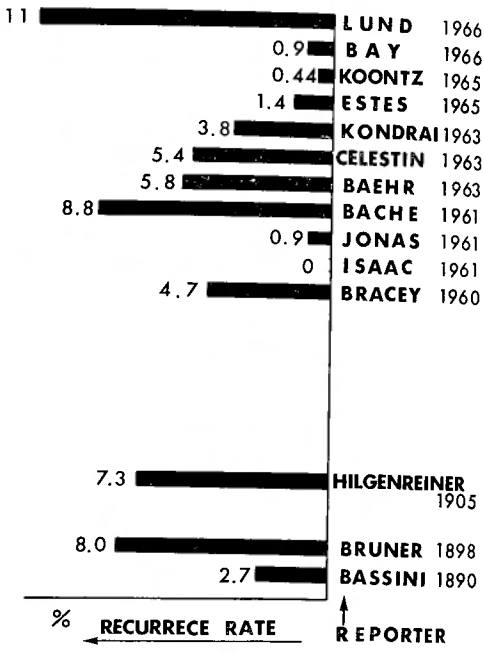


Fig. 42 Recurrence rate of the inguinal hernia repair, reported in Europe and America.

we feel that reinforcement of the internal inguinal ring was not accomplished. In 5 cases the recurrent hernias formed a lump in the inguinal region and had been diagnosed as direct hernia in type. Surgical exposure revealed that they were actually of the indirect type; the hernial sac could slide in the widely opened internal inguinal ring which was untreated in the previous operation but not pass through the external inguinal ring which was tightly closed by approximating the inferior edge of the internal oblique and the lateral edge of the rectus sheath to the inguinal ligament in the previous operation (Fig. 37).

In the remainder of the 7 cases the recurrent hernial sac descended again into the scrotum due to unsatisfactory reconstruction; and suturing the internal oblique muscle to the inguinal ligament which was started too low sac apart from the internal inguinal ring and and incomplete in the low portion of the inguinal canal (Fig. 43).

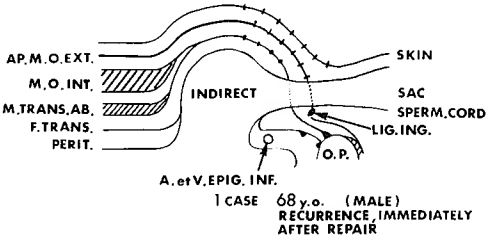


Fig. 43 Diagrammatic representation of a type of recurent hernia. The previous operation is concluded to be similar to the HATAKOSHI method. Only a few sutures were placed between the internal oblique muscle and the inguinal ligamet.

In the case of the 4 year old male infant the recurrence was of the direct type and the previous hernia was considered to have been inner inguinal hernia in type.

These facts show that techiques still must be greatly improved for reinforcement of the inguinal canal in Japan.

In general, recurrence of the hernia, if the HATAKOSHI method has been used correctly, occurs mostly in the aged patient and rarely

in infants. Recurrence in infants is related to improper operative technique.

The recurrence rate in our hospital was 1.7% in 351 cases of repaired hernias during 6 years (1950-1955) when many surgeons of our hospital performed the surgery of hernia, but it decreased to 0.09% in 2060 cases during 10 years (1956-1966) where all cases of inguinal hernia were operated by the chief surgeon, JIRO MURAKAMI in order to reduce the rate of recurrence in our hospital.

V. CONCLUSION

The establishment of a new method, improvement of existing techniques and continuing appraisal of their rationale contributing greatly to progress in the field of natural science are described.

Professor TORIGATA, our late teacher and the proponent of the HATAKOSHI method, once expressed an opinion about operative methods by mediating an argument about a certain procedure, stating that "all established techniques should be flexible in our practice".

In this paper we acknowledged the value of HATAKOSHI method for repair of hernias, the indications were presented and the current status of hernia repair utilizing a variety of modifications of the so called HATAKOSHI were reviewed.

Views similar to those presented in this paper were reported at the meeting of *INTERNATIONAL COLLEGE OF SURGEONS*, the *1ST CONGRESS* of the *ASIAN FEDERATION*, the *14TH ANNUAL CONGRESS* of the *JAPANESE SECTION*, October 12th, 1967.

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和文抄録

そけいヘルニアにおける波多腰法とその応用

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そけいヘルニア根治手術術式の個々の点にプリオリティーを論ずるのは困難なことであるが，その発展の歴史をかえりみると，内そけい輪でのヘルニア嚢高位切断結紮に関する Marcy (1871), Sir William Macewen (1886), Lucas Championniere (1892), Ferguson (1899), そけい部壁形成的強化に関するBassini(1884), Halsted (1889), Andrews (1895), McVay (1942), そけい部壁補綴材料使用に関する McArthur (1901), Koontz (1950), Doran (1961), 高位結紮切断後ヘルニア嚢残置に関する波多腰 (1911) 等の業績は高く評価してよいと我々は考える．

波多腰原法について波多腰氏は“内そけい輪で嚢を切断結紮し，その上に1～2針のファスチァ縫合をやればこれで充分”と要約，Marcy 法に似た簡単な壁形成を提案した．波多腰法には第1法として内そけい輪直上にあたる内斜腹筋の筋線維を分けて内そけい輪に達するやり方と，第2法と呼び同氏も普通行なつていた，内斜腹筋外縁上部に鉤をかけてこれを上方に挙上，その下で内そけい輪を展開する技法とがある．1966年九大池田が全日本多数の大病院にアンケートして調査した報告によれば，乳幼児そけいヘルニアには Ferguson 法，成人には Bassini 法が多く採用され，波多腰法を採用すると回答した病院はややすくない．そけいヘルニアにはすべて波多腰法を行なうと回答した大病院は7つ，すべて京大系であつた．この回答の内で，しかし，波多腰法と答えた病院が採つている術式がヘルニア嚢を残置する以外は Ferguson 法に近いことが考えられ，Ferguson法と答えた病院の術式がヘルニア嚢を残置する点で波多腰変法と呼んでよい場合もあると推定せられるので，池田のアンケートの結果を我々は寧ろ精管転移法（Bassini, McVay 等）と精管不転移法（Ferguson, 波多腰等）との採用の現状の報告と見るのが妥当ではないかと考える．

本論文では改めて波多腰原法を紹介すると共に，その術式から出発したそけいヘルニア根治手術を35年間行なつた現在，我々がいかなる程度に本法を利用しているか，また波多腰法と称して原法から改変せられて広く行なわれている術式に，成人・老人では再発が多い点を述べて諸家の反省を促したいと思う．

波多腰法はその原著で第1法として内斜腹筋をひらき，内そけい輪に直達し，ヘルニア嚢を高位切断結紮し，これを覆うように Spiegeli 線とそけい靱帯を1～2針で縫合と記載しているが，このような内そけい輪の展開法では視野にそけい靱帯は露出せず，氏がそけい靱帯としたのは Tractus iliopubicum（Fascia transversalis のそけい靱帯に平行した肥厚部で M. transversus abdominis の Aponeurosis に覆われて，この程度ではこれに密着しているのが普通である）であつて，真のそけい靱帯は内斜腹筋にへだてられてその外にある．即ち，第1法で Spiegeli 線と氏が縫合したのは Tractus iliopubicum であつたと考えられる．第2法では Tractus iliopubicum よりも見分け易いそけい靱帯が直視下にあるので同氏はおそらく内斜腹筋のそけい靱帯付着部以下では Spiegeli 線と真のそけい靱帯とを縫合したであろう．しかしこの場合でもこの付着部より上方の内そけい輪直上におけるそけい部壁強化縫合には，若し実際に行なうとすればそけい靱帯を利用するよりも Tractus iliopubicum を利用する方が簡単である．同法の後半として波多腰原法がその重大性を強調している外斜腹筋アポノイローシスの形成的縫縮（波多腰氏の Canalnaht）を我々はそれほど必要とは考えないし，これはまた我々ばかりではなく，最近の世界的傾向である．出来るだけ腹膜面に接して形成的強化縫合がしてあれば，外斜腹筋などの腹膜面から離れたところの強化はそれ程必要ではないのである．

我々が現在採用している術式は波多腰法の前半がその基本になつているが，症例毎にそのヘルニアの構成に応じた適当な工夫を先人の考案した種々な術式を混合採用して行ない，決して単一なものではない．乳幼児には内そけい輪上に1～2針かけるだけで，波多腰法の後半を行わないものが多く，内輪が大きい場合や内斜腹筋の発達の悪い症例，Hesselbach 三角の弱い症例

では乳幼児であつても Tractus iliopubicum（途中からそけい靱帯に代わることもある）とSpiegeli 線，Conjoined Tendon と呼ばれる腱様組織とを，ずつと下方まで延してコッヘル氏鉗子が楽に通るだけの孔を精系通過のために残すこともある．成人，老人では原則的に精系転移法を採用し，腹壁の老人性弱化の著明な症例や再発そけいヘルニア，直接ヘルニアに対してはテフロンメッシを応用した補綴的壁強化をこれに追加し，縫合における組織の過緊張は避ける．

波多腰博士は御逝去にさきだつて御病床から波多腰法に関する世上の無理解について切実な手紙を私に送つて来られた．その写真の一部をここにかかげて，本論文を故博士に捧げる．因みに本論文の要旨は1967年10月国際外科学会アジア連合会第1回総会全日本部会第14回総会に報告せられた．